Corporation ("Comsat") noted that the precise band segments requested for allocation by TRW are more appropriate for feeder links to sustain an RDSS-band system than are other Ka-Band segments.[13/] Comsat observed that the selected segments were already allocated for mobile use, and asserted that utilization of the segments would avoid potential coordination problems with the fixed-satellite service.[14/]

In this last regard, TRW is compelled to address a claim advanced by Norris Satellite Communications, Inc. ("Norris") in its comments in response to Motorola's application. Norris urges the Commission not to authorize use of the Ka-Band for feeder links for non-geostationary satellite systems until a methodology is developed for the coordination of non-geostationary systems with Norris's proposed geostationary Ka-Band domestic satellite.[15/] Norris also observes that International Telecommunication Union ("ITU") Radio Regulation 2613 requires non-geostationary space stations to cease or reduce operations under certain circumstances if

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13/ Comsat Comments in File Nos. 9-DSS-P-1(87) et al., at 22-23.

14/ Id. at 23.

15/ Norris has applied to use 1400 MHz of Ka-Band spectrum for its "NorStar" fixed, mobile, and point-to-multipoint satellite system. Norris requests allocations in the 29.3-30 GHz and 19.5-20.2 GHz bands. Norris Comments in File Nos. 9-DSS-P-91(87), et al., at 1-2.

unacceptable interference is caused to fixed-satellite service stations operating in accordance with the Regulations.[16/]

Norris's call for a coordination condition on non-geostationary satellite system use of the Ka-Band for feeder links is premature. Norris's NorStar system has not even been approved by the Commission. In any event, the Commission has generally refused to withhold satellite authorizations solely because another operator claims the potential for harmful interference. It expects instead that the operators will attempt to resolve potential interference through informal coordination, and eschews Commission involvement unless the parties are unable to agree.[17/] As no informal discussions between Norris and any non-geostationary systems proposing Ka-Band feeder links have occurred, its request for any coordination obligation is unripe.

With regard to Norris's reliance on ITU Radio Regulation 2613, TRW makes two observations. First, the regulation itself is an anachronism -- having been developed for application in an era when non-geostationary satellite systems did not appear poised to play a major role in global commercial communications. The Commission has questioned the

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16/ Norris Comments at 3.

17/ See Orion Satellite Corporation, 5 FCC Rcd 4937, 4938 (1990).

continuing vitality of the regulation,[18/] and it is doubtful that the regulation will play a role in the future.

Second, the regulation is applicable only as between non-geostationary satellites and geostationary satellites operating in the fixed-satellite service. While Norris's NorStar satellite would be a geostationary satellite, RR 2613 would be inapplicable on its face as Norris proposes to operate NorStar as a "General Satellite Service" spacecraft.[19/]

Clearly, there are matters concerning the interoperability of geostationary and non-geostationary satellites at the Ka-Band that will have to be addressed over time. It simply is TRW's position that the comments filed by Norris do nothing to undermine TRW's petition for allocation of 110 MHz of spectrum in the 29.5-30 GHz and 110 MHz of spectrum in the 19.7-20.2 GHz bands as feeder links for TRW's proposed M-E RDSS service. The Commission should proceed with TRW's proposal.

18/ <u>See Supplemental Notice of Inquiry in Gen. Docket No. 89-554 (WARC '92)</u>, 6 FCC Rcd 1914, 1917 (1991).

19/ Norris Comments at 1 n.1.

V. **TRW Should Be Granted A Pioneer's Preference For Its Proposal To Enhance The Use Of The RDSS Bands.**

Recently, the Commission adopted a new rule that provides parties seeking rule changes that would permit the development and implementation of innovative technologies the opportunity to receive preferential treatment in a licensing proceeding for the new or enhanced services.[20/] In embracing the concept of a "pioneer's preference," the Commission expressed its belief that it would foster both the development of new services and the enhancement of existing ones by reducing the delays and risks faced by innovators.[21/]

TRW hereby requests a pioneer's preference for its Odyssey system in accordance with the procedure recently adopted by the Commission. As demonstrated herein, the Odyssey system meets and surpasses the criteria established for granting such preferences.

In the Pioneer's Preference Order, the Commission announced that a preference will be granted to an applicant proposing "to provide either a service not currently provided

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20/ Establishment of Procedures to Provide a Preference to Applicants Proposing an Allocation for New Services, GEN Docket No. 90-217, FCC 91-112 (released May 13, 1991) ("Pioneer's Preference Order").

21/ Pioneer's Preference Order, FCC 91-112, slip op. at 2.

or a substantial enhancement to an existing service."[22/] TRW's proposal will satisfy both of these criteria. First, the Odyssey system will permit the long-authorized (but never operational) RDSS service to become a reality. Second, it will utilize new technology to offer other publicly-beneficial services not envisioned when the service was established. The Odyssey system's ability to provide fully compatible spread spectrum mobile voice and data satellite services will not only serve the public interest by meeting unsatisfied demand, it will do so in a highly spectrum-efficient manner. See Section II, infra.

Indeed, the Odyssey system squarely promotes the interests listed by the Commission as guiding factors in its consideration of requests for preferential grants. These include "added functionality," different use of spectrum than previously available, a change in the operating or technical characteristics of a service, efficient spectrum use, enhanced speed or quality of information transfer, spectrum sharing, and reduction of costs to the public.[23/] The Odyssey system will satisfy every one of these factors, ample evidence that TRW is proposing the type of innovative spectrum use that the Commission intended to recognize with the pioneer's preference.

22/ Id. at 18.

23/ Id.

As the developer of the Odyssey system, TRW deserves the opportunity to bring this innovative technology to the marketplace. TRW has expended significant time and substantial company resources to refine spread spectrum technology and investigate new ways to provide a broad range of telecommunications services. These technological refinements have allowed it to conceive and design an RDSS system that is at once highly functional, technically feasible, and economically viable.[24/] This development process has drawn upon all aspects of TRW's broad experience as a pioneer and leader in satellite technology, experience which should allow expeditious inauguration of efficient, affordable service once the system is authorized.

Finally, because the new M-E RDSS service is inherently nationwide (indeed, international) in scope, the market guaranteed to TRW by a preferential grant also should be nationwide. Other inherent characteristics of the M-E RDSS service -- in particular, the use of spread spectrum technology -- will allow competing companies to provide service on shared frequencies throughout the same broad market. Thus, the grant

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24/ A comprehensive demonstration of the technical feasibility of the Odyssey system, and of TRW's technical qualifications to implement that system, are presented in TRW's Odyssey system application. See TRW Odyssey Application, File Nos. ________________, at Section IV (filed May 31, 1991).

of a nationwide pioneer's preference is both warranted and reasonable.

For the foregoing reasons, TRW respectfully requests that the Commission grant it a pioneer's preference to operate its Odyssey system using the frequencies 1610-1626.5 MHz in the L-Band and 2483.5-2500 MHz in the S-Band, with feeder links at 19.7-20.2 and 29.5-30.0 GHz in the Ka-Band.

VI. Conclusion

TRW's regulatory proposal for the RDSS bands and Ka-Band feeder links represents an innovative and efficient use of spectrum. It significantly enhances the existing RDSS allocation by incorporating spread spectrum voice and data services and creating a new, innovative offering -- Mobile-Enhanced RDSS. Moreover, the proposal is capable of being implemented on an expedited basis through the application of the existing RDSS service licensing rules and policies. Accordingly, TRW respectfully requests the Commission to issue a notice of proposed rule making to implement the proposal advanced in this petition, and to grant TRW's request for a Pioneer's Preference.

Respectfully submitted,

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July 8, 1991

Its Attorneys

ATTACHMENT

Analysis of the Impact of the Existing PFD Limits on the Capacity of the RDSS/MSS Systems

Introduction

The following discussion explores the relation between the allowable power flux density (PFD) attendant to a CDMA RDSS/MSS system and the maximum number of users that the system may serve. The following discussion shows that the maximum number of users that can be served is directly related to the PFD limits. Low PFD limits result in fewer users being available to form the economic base upon which a system can be constructed and operated. Thus, in a multiple entry environment, restrictive PFD limits will artificially limit the number of potentially competing systems because the user base is reduced by regulatory factors and not the communication system technology.

Methodology

Given the parameters found in a competent link budget it is possible to derive a relation between the number of users served by a CDMA modulated RDSS/MSS system, and the power flux density measured at the surface of the earth. The approach is summarized here and detailed in Appendix A:

(1) The value of three parameters are calculated from the link budget, C/(N+I), C/I and N, where C is the carrier power, N is the receiver noise power and I the code noise interference.

(2) Knowing these three parameters allows three equations to be set up in three unknowns (C,N and I).

(3) The carrier power (C) can be solved for as a function of the number of users served by the system and other known link parameters. The PFD is simply a function of the sum of the carrier powers required to serve all of the users.

The derivation of the required carrier power and the PFD is presented in Appendix A. The remainder of this discussion uses the link parameters shown in Table 1. It should be noted that different communications parameters will produce somewhat different numerical results, but ,in general, the same principles will hold.

Table 1 Example Communications Link Parameters

Frequency	2.5	GHz
No. Channels in Allocation	3	
Channel Bandwidth	5.0	MHz
Required Eb/(No+Io)	5.3	dB
Link Margin	1.5	dB
Data Rate	5.5	kbps
Receiver G/T	-20.0	dB/K
User Antenna Gain	3.0	dBi

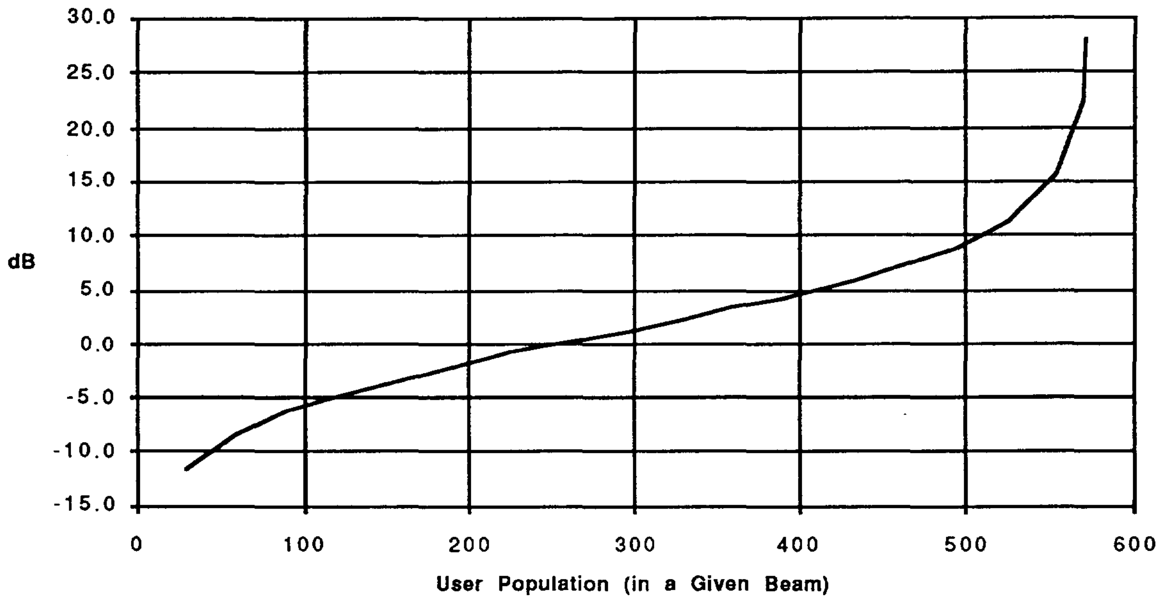
Discussion

Figure 1 shows the PFD as a function of the number of simultaneous users for the communications link parameters given in Table 1. The number of users should be interpreted as the users, in a given coverage region on the Earth's surface, simultaneously receiving from one one or more RDSS/MSS systems. If a .35 voice activation factor applies then approximately 3 times the number of active users would actually be being served by the RDSS/MSS systems. Note also, that all three channels are assumed to be in use.

The curve shown in Figure 1 has a (near) linear region from about 100 users to about 500 users. This linear section of the curve indicates that serving an additional user will result in a linear increase in the PFD. Going above about 500 users requires an increasing level of carrier power per user until an upper limit is reached where the channel breaks down. This increasing carrier power per user shows up as a rapidly increasing PFD with an increasing number of users above about 500.

The left hand axis of the figure is labeled in dB relative to the current ITU PFD limit for the 2483.5 to 2500 MHz frequency band. At the PFD limit (i.e., 0 dB on the chart), the maximum number of users is about 260 (or 780 users with a voice activation factor of 0.35). This indicates that only about half the number of users would be served than could be if higher PFDs were permitted. To constrain the RDSS/MSS operations to the current PFD limits means that all of the Applicant systems combined can serve only some 260 users in a given coverage region. Allowing an increase in PFD by about 9 dB effectively doubles the number of users in a given region and makes multiple entry economically feasible for more systems.

Figure 1 - Received Flux Density for a Given User Population (Relative to -144 dBW/m2/ 4kHz)



Because each separate region, or beam area, can support the same number of users, the most efficient use of the frequency band will be by the system or systems that serve the highest number of independent regions, i.e., multibeam systems. A system that uses a single beam to cover the U.S. could, at most, serve about simultaneous 500 users, assuming no other RDSS/MSS systems existed. A multibeam system can serve approximately 500 users in each beam.

In fact, a single beam system reduces the total number of users that can be served in a given area if multibeam systems are available. This comes about because the single beam systems radiate the entire CONUS while the multibeam transmit to selected regions. For example, a single beam system that can "see" the entire CONUS will give interference to all of the users of all of the systems operating in CONUS, with the exception of the single user it is trying to reach. By way of contrast, in a multibeam system such as Odyssey, each individual channel will be isolated from the majority of users in CONUS by the narrowness of the antenna beam.

Impact on Terrestrial Systems

The PFD limits exist to protect terrestrial systems from interference due to satellite transmissions. The original basis of these limits was a computer study that modeled interference from geostationary satellites, placed at 3 degree intervals along the geostationary orbit, into long-line line-of-sight systems at 4 GHz. In 1984, NTIA published a report on the the impact of increasing the PFD limits on selected S-Band terrestrial systems[1]. These systems included ENG, STL, Inter-City TV Relay and TV Translator stations operating in the 2025 to 2300 MHz band. These are the same generic types of systems that occupy the 2483.5 to 2500 MHz band. The NTIA study indicated that a maximum PFD limit of -134 dBW/m^2 4kHz would be compatible with the operation of these terrestrial services. This value is 10 dB above the existing ITU PFD limits. The PFD limit, derived above, that would double the potential user base for the RDSS/MSS systems is about 9 dB above existing ITU limit and is therefore compatible with the terrestrial systems in the RDSS S-Band.

[1] Assessment of Satellite Power Flux-Density in the 2025 to 2300 MHz Frequency Range, Part II, NTIA Report 84-152 (1984).

Appendix A : Derivation of Carrier Power and Power Flux Density as a Function of the Number of Users

The following three quantities can be determined from the values usually given in a complete link budget.

(1) $C/(N+I) = \beta$

(2) $N = kTB = \Omega$

(3) $C/I = 10 \text{ Log(No. Users -1)} = \mu$

Where :

C =	Carrier Power
N =	Receiver Noise Power
I =	Interference Power
k =	Boltzmann's Constant
B =	Channel Bandwidth
T =	Receiver Noise Temperature

The terms in equations (1) to (3) are obtained from the link budgets as follows:

- The carrier to noise plus interference density ratio, C/(N+I), is derived from the required Eb/(No+Io), the data rate and the channel bandwidth;
- The receiver noise power, N, is obtained from the user receiver G/T, the user antenna gain and the channel bandwidth, and
- The carrier-to-interference ratio, C/I, is assumed to be a function of the number of users simultaneously in operation in a given region.

Solving Equations (1) to (3) for C yields, $C = \beta\Omega / (1-\beta/\mu)$, where the real value of the parameters are used.

This is the value of the carrier power required to produce a given C/(N+I) ratio in the presents of interference from a known number of users and a specified receiver noise temperature. The power flux density resulting from this carrier power can be obtained by backing the value of C through the antenna to obtain an equivalent flux density. The total power flux density is the sum of the flux densities required to support the total number of users.

TECHNICAL CERTIFICATE

I, Paul Locke, hereby certify that I am the technically qualified person responsible for preparation of the technical information contained in the foregoing Petition for Rule Making and Request for Pioneer's Preference, including the Attachment thereto. Under penalty of perjury, the technical information presented is complete and accurate to the best of my knowledge.

Dated this 8th day of July 1991

By: Paul Locke
Paul Locke
Consulting Engineer